An Overview of GPS Occultations Focusing on Retrieving Water Vapor

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Occultation observations using GPS provide a limb-viewing, long-wavelength remote sensing technique which provides globally distributed, high vertical resolution profiles of the atmosphere which are insensitive to clouds. These observations yield profiles of refractivity versus height which is proportional to the dry density plus water vapor density. In regions of the troposphere colder than ~230 K and throughout the stratosphere, the moisture contribution is negligible and the dry density portion yields profiles of temperature and geopotential with accuracies of 0.3 K and 10 m respectively with vertical resolutions of ~1 km. In warmer regions, the water vapor contribution to refractivity yields a water vapor molecule counter or specific humidity meter (in contrast to a relative humidity sensor). Given knowledge of temperature to an accuracy of 1.5 K, specific humidity can be recovered with an accuracy of 0.2 g/kg in drier regions increasing to 0.5 to 1 g/kg in very moist regions. The moisture, temperature and pressure information can be extracted from the GPS observations in an optimal way by combining the GPS observations with background information from weather analyses using a least squares approach based upon their respective error covariances. Initial 1DVar results combining occultation refractivity profiles with ECMWF analyses are promising and indicate that the initial error covariances are not far from optimal. The presentation will summarize the occultation technique, expected performance and initial results focusing largely on retrieval of moisture.